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A Study of Supply Chain Operations Delay Causes and Its Impact on Oil and Gas Projects

SHORT SYNOPSIS

Submitted in partial fulfillment of the requirement of the degree of

DOCTOR OF PHILOSOPHY

to

Manav Rachna International Institute of Research and Studies
(Deemed to be University)

by

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Certificate

I hereby declare that the short synopsis **"A Study of Supply Chain Operations Delay Causes and Its Impact on Oil and Gas Projects"** being submitted in partial fulfillment of the requirement for the degree of Doctor of Philosophy in Management under faculty of Management Studies of Manav Rachna International Institute of Research & Studies, Faridabad during the academic year 2021.

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ABSTRACT

Oil and gas Engineering Procurement and Construction (EPC) projects are complex technology driven. Each project having unique challenges and opportunities. Project success is strongly communicated on the basis of project completion within budget, within schedule, technical design compliance along with meeting shareholders expectation of internationally recognized standard of quality and safety. Ministry of Statistics and Programme Implementation has reported Mega projects cost overrun in the range of 5.8% to 114.26% and schedule delays from 3 Months to 112 Months (MOSPI, 2020).

Oil and gas sector projects fulfill appx. 32% of overall energy demand of India (IEA, 2020). The objective of this study to investigate the performance of oil and gas projects. Further research on mega projects to find out supply chain operations delay causes and its impacts on oil and gas projects and develop a framework to improve supply chain operations performance. Also study current industry best strategies and practices under consideration to overcome with the said challenges.

The sustainable long run business is the present need of the industry. The study will help policy makers and industry leaders to develop mitigation majors, appropriate strategies and best practices to reduce the delays and their impact on project business of oil and gas sector lead to sustainable business.

Key words: EPC, Procurement Strategies, Contracts, Project Management, Supply Chain, Procurement Practices, Mega Projects

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1. Introduction

Oil and gas industry having 3 main segments Upstream, Midstream and Downstream. Upstream segment comprising of business related to crude and gas exploration and production (E&P). Midstream segment comprising of business related to transportation of crudes and gases from the rig to the storage terminals. Downstream segment comprising of refining of crude oil and processing and purification of raw natural gas and further logistic and distribution to the consumers (TechnipFMC, 2018). Construction of Mega Refinery, petrochemical plants, petroleum by product plants, laying of pipelines, and gas treatments units are coming under Capital projects. Oil and gas Capital EPC project success is fully depending on multiple discreate business entities: experienced contractors, technology licenser, project engineering consultants, project management consultants, critical package suppliers and owners, local authorities, investors, etc to ensure on time, within budget and of the required quality (Keane and Caletka, 2008).

1.1 Industry Background

IBEF (2021) Indian refining capacity stood at 259.3 million metric tonnes (MMT). Indian petroleum Industry is 2nd largest refiner in Asia. Data clarifies us that Indian Refineries are working at their 100% capacities considering fulfilling current requirements and to ensure emergency reserves for the sudden country's demand of petroleum products. Crude oil consumption is expected to grow at a Compound Annual Growth Rate (CAGR) of 3.60% to 500 million tonnes with the aid of 2040 from 221.56 million tonnes in 2017. natural gasoline consumption is forecast to boom at a CAGR of 4.18% to143.08 million tonnes by using 2040 from 58.10 million tonnes in 2018. Foreign Direct Investment (FDI) in oil and gas industry with favoring Government policies petroleum and natural gas sector stood at USD 7.91 billion during April 2000-December 2020.

Indian Government has planned investment of USD 206 billion in next 8 to 10 years in petroleum sector (IBEF, 2021). Indian Oil Corporation (IOC) would like to double their refinery capacity from current 80.7 million tonnes per annum to 150 million tonnes by the year 2030.

Project owner's main concern is timely completion of Capital projects within pre-defined schedule, within set budget, meeting international quality and safety standards. To ensure project owners award capital project to the EPC Contractors after detailed assessment of their industry experiences and company credentials consider best in class technical skills, management experience, financial stabilities at the minimum. Almost every capital project is executed by integrated team independent EPC Contractors. Mega projects are planned to execute based on EPC, EPCm, EPCC, EPCS and EPCI model approaches. Further industry mostly using contracting approaches/types such as Lump-Sum Trunkey, Unit price, Cost Plus Contracts etc.

Oil and gas EPC projects are similar to any other construction industry projects where detailed scheduling, planning, monitoring, management reporting and control activities are considered critical on project. However, EPC oil and gas projects are more challenging because of their unique features: (1) High-technology driven, made to order key equipment's (2) Project sites and camps are located in remote areas leads to unique communication and logistical challenges (3) Involvement of different technical fields exports are highly demanding to solve high technology integration challenges (IEA, 2020; Dey, 2012) and (4) capital project execution keep facing considerable environmental and social impacts (Dey, 2012).

1.2 Current Industry Sustainability Challenges

In today's global competitive environment Engineering, Procurement & Construction (EPC) Industry's Owners / Clients / Project Management Consultants / Engineering Consultants / Contractors are facing lots of challenges towards project success which leads to sustainable business. Companies operating profit margins (OPM) are reducing drastically. For examples: Technip FMC operating profit margins were reduced from 14.51% (Dec-2014) to -11.39% (Dec-2019). ExxonMobil operating profit margins were reduced from 12.53% (Dec-2014) to 7.57% (Dec-2019). Chevron operating profit margins were reduced from 14.72% (Dec-2014) to 3.78% (Dec-2019). Engineers India Ltd. (EIL) profit margins were reduced from 26.00% (Mar-2014) to 14.00% (Mar-2020). Punj Lloyd Ltd. profit margins were reduced from 3.00% (Mar-2014) to -10.00% (Mar-2018). 2019 & 2020 data not available. Fluor Corporation operating profit margins were reduced from 5.65% (Dec-2014) to -8.76% (Dec-2019). Big oil and gas companies like ExxonMobil, BP and Shell each reported 2020 losses in the

range of USD20.3- USD22.4 billion. Even though as per the Global Oil market report the price of WTI crude recently approached pre-COVID-19 levels (BIC Magazine, 2021 Mar/Apr).

All parties involved cannot be have same objectives, however they can work together towards achieving same aim, that is to achieve overall project success (Wu, 2011). Research studies are conveying clear message that, irrespective of the industry type mega projects success is measured on five main criteria. They are within schedule, within pre-set budget, satisfying all technical outcomes, meeting the predefined quality standards and safe execution on the top. Identification of critical factors accountable for unpredictability, failure along with the monitoring of success factors of the projects need urgent & continues attention.

To aiming this in-depth exploratory fact finder will be undertaken to capture mega project "delay causes", "Impact of delays" and investigating current strategies to overcome with project challenges & problems. A literature study will be organized to keep focus on Oil & Gas: refineries, pipeline and petroleum industries doing business in downstream segments. Region under focus is "India, countries under Asia Continent".

1.3 Current Strategies to Overcome Challenges

To achieve project success and business sustainability global EPC Contractors are acting strategically such as: doing Project business in joint ventures, restricting their business lines, selling their business lines, opting for mergers & acquisitions and separation into two industry-leading companies. Industry examples related to such business strategies are written below:

Project & Business Sustainability Strategy	Industry business Example
Doing project business in Joint Ventures	October, 2015 : Kuwait Integrated Petroleum Industries Company (KIPIC) awarded package 2 & 3 on EPC Lump sum basis to Fluor, Daewoo and Hyundia (FDH JV). Project Cost is $5.75 billon out of total investment of $13 billion for the new Al-Zour Refinery project.

Restricting their business lines	January, 2021: Fluor has announced updated business organizational and reporting structure. Fluor strategic decision to operate further in three business segments: "Mission Solutions", "Energy Solutions", and "Urban Solutions". It will ensure effective and timely capturing of identified growth markets.
Selling their business lines	June, 2020: McDermott International Inc. has sold the former pipe fabrication assets of The Shaw Group.
Opting for mergers & acquisitions	February, 2017: Merger of Engineering Projects India Ltd, MECON, Telecommunications Consultants India Ltd., WAPCOS, etc, with Engineers India Limited (EIL).
Separation into Two Industry-Leading Companies (During Covid-19)	January, 2021: TechnipFMC plc (NYSE :FTI) Declares their separation into two Independent, Publicly Traded, Industry - leading Companies. TechnipFMC's and Technip Energies' can now more effectively work towards respective strategies based on their strengths and can demonstrate improved flexibility and growth opportunities.

2. Literature Review

Literature studies captured from the professional global consulting firms and published academics researchers prospective to understand the mega EPC projects "delay causes", "Impact of delays" and investigating current strategies to overcome with project challenges in the context of EPC Contractors Supply Chain operations.

2.1 Global Consulting Firms Prospective

KPMG and PMI (2013) conducted study under assistance of Government of India, Ministry of Statistics and Programme Implementation (MOSPI). The study primary focused on the reasons for time & cost overruns in the central sector Infrastructure projects: There are internal factors (planning, integration and effective project management) & external factors (land acquisition, regulatory approvals etc.) are accountable for schedule and cost overruns. external factors are beyond the control of implementing Agencies (Owner/Contractor/Client/PMC/licensers/suppliers). Deloitte (2014) report on "Global Scenarios for the oil & gas industry-Vision 2040" reported

that in oil & gas projects cost & schedule overruns are always a key challenge, due to each project having unique scenarios such as; Technology advancement, supply & demand, prices, business models, sustainability, demographic change, armed conflicts and geopolitical disputes. EYGM research report "Engineering, Procurement & Construction (EPC): Making India brick by brick" on Indian EPC industry, reported delay challenges such as : a) Regulatory challenges resulting time and cost overruns, b) Project planning and implementation stages challenges and c) Unviable bidding and Challenges relating to financing (EYGM, 2014). Subsequent, EYGM "spotlight on oil and gas megaprojects" report concluded that globally 64% mega projects reported over budget and 73% reported schedule slippages. Whereas in Asia-Pacific mega projects reported 68% cost overruns and 80% schedule delays (EYGM, 2015).

Deloitte (2015) reports have conveyed, traditional planning and execution methods are often ineffective in monitoring capital projects. Report addresses six of the oil and gas industry issues currently impacting: Emergence of new trade patterns, at least short-term market role of OPEC's, LNG prices, An anticipated shift in supply-chain fundamentals, growing business strategies between integrated oil companies and national oil companies and design complicated projects long term cost. Reports also highlighted several reasons for overruns ranging from regulatory mandates, rising labour and material cost, mounting technical and geopolitical risks.

PWC (2016) In their report stated that project fails due to Contractor's inability to achieve prime contract (contract between Owner and Contractor) specified performance guarantees parameters (technical Output, efficiency and reliability). Events that are unforeseeable and or/unlikely during project execution are reported as a key reason of schedule delay & cost overruns. PMCs and Owner collaborate with EPC contractor to perform "unforeseen event budget allocation" can helps to overcome with such problems. EYGM (2017) report on "Oil and gas megaproject development : Project development to FID" investigated that overall project challenges are further aggravating because of low oil prices, complexity of technical design, increasing project size, high integration and geographical and political uncertainty. McKinsey & Company (2021, February) special report on "Capital Projects 5.0: Reimagining capital-project delivery" has also addressed key issue related to project execution cycle major sources of value losses (Cost & Schedule overruns).

2.2 Published Academic Research Prospective

It is evident that mega EPC project execution is always a key challenge. Industry need to put best possible efforts to find the challenges and work towards overcoming. In the literature study we are capturing potential key facts & evidence related to "delay Cause", "impact of delays", "project & business risk" and "project & organizational success stories". Study of these key area will help to develop best project execution & operational strategies, practices in the context of EPC Contractor's supply chain operations.

Ahsan and Gunawan (2010) conducted study sponsored by Asian Development Bank and hosted by India, China, Bangladesh and Thailand. In this study there are 100 International Development (ID) infrastructure projects were studied. Project capital cost per project varies from USD 126 million to USD 418 million. Data representation percentages among the countries China, Bangladesh, India and Thailand are 30%, 31%, 20% and 19% respectively. This unique empirical research reported, major causes of delay are:, delay in material procurement, contract evaluation & award lengthy procedures, delay in land acquisition & civil works, natural calamities and host country bureaucracy.

Dey (2010) has developed and analyzed project execution risks such as : "work package level risk", "project level risk" and "activity level risk". And also established meaningful responses to address the issues like technological, financial, environmental and management plans. To check the developed integrated framework effectiveness, it was implemented on project "oil pipeline construction project-1500km". Analytic hierarchy process (AHP) and Risk map framework enable project management towards calculated risk decision making and selecting project having minimum risk with keeping all project stakeholders under confidence.

Dey (2012) conducted study to determine risk factors in refinery construction project in central part of India. Risk factors and their corresponding Sub-factors are: 1. Technical risk (Such as : Technology selection, scope change, implementation

methodology selection, material risk, equipment risk and Engineering & design Changes).

2. Financial and economical risk (Such as : Fund risk, inflation risk, Changes in government policy, local law changes, and cost estimation errors)

3. Organisational risk, (Client's maturity, contractors' maturity, Suppliers' maturity and consultants' maturity).

4. Natural hazards : (Rain, flood, subsidence, fire and heat)

5. Clearance risk (Environment, Land Acquisition, Explosive Clearance and Other Clearance).

In study four work packages are identified and their severity of risk has been studied. Study reported technical risk-scope change is having major severity to harm the project performance. Survey data on critical work packages reported expected time and expected monitory value (EMV) of cost overrun in the range of 5 months & 30 Million US$ respectively.

Doloi et al. (2012a) were selected 45 delays attributes for the available literature, and further categories these attributes into 6 broad categories of construction project execution: process related, project related, human related, site related, technical issues and authority related. Then survey results were examine using factor analysis and regression modelling to understand the significance of identified 45 delay attributes. Finally research results identified most critical factors of construction delays as : lack of commitment, poor site coordination; inefficient site management; lack of clarity in project scope, improper planning, lack of communication and substandard contract.

Doloi et al. (2012b) study is the extension to the previous study Dolio et al. (2012a). Where author presented previous study finding to the team of experts working on Construction project size USD 100 Million to USD 600 Millon. There are key suggestion offered by them leads to further modification on key factors and their corresponding attributes, study further identified four latent variable factors: lack of commitment (LC), contractor's inefficiency (CNI), client's influence (CI) and improper planning (IP). 19 delay attributes /indicators were further investigated using The Structural Equation Model (SEM), results recommended only one key variable factor out of 4 identified which is Client's influence (CI). Client's influence accountable for the significant impact on time performance in construction industry. Attributed

accountable for delay in design and scope changes, lack of stringent organizational protocol and during construction change of subcontractors are the most.

Ruqaishi and Bashir (2015) conducted literature review & then performed case study on oil & gas processing facilities in Oman to find causes of delay projects execution. Study identified problems with subcontractors, poor interaction with vendors in the engineering and procurement stages and delay in delivery of materials are majorly concern with oil and gas industry EPC Supply chain operations.

Kazemi et al. (2018) performed in-depth literature study to investigate delay causes in Irani oil and gas projects. Researcher has grouped identified factors causing delay available in literature into 4 kay groups consultant, owner, contractor and other factors. However, delay in reviewing of documents by consultant, change orders and changes in scope of work by owner, inadequate experience and knowledge, low productivity of laborer and errors during construction by contractor are potential delay causes.

Alhajri and Alshibani (2018) had performed comprehensive literature review and after obtaining experts suggestion working on highly complicated EPC model Mega projects in Saudi Arabia, researcher have resulted in identifying 23 potential factors (21 from Literature + 2 from expert interview) causing petroleum projects delay. Survey data ware analyzed using frequency adjusted Importance Index (FAII) considering strong relationship between contractor and owner for potential delay factors. The analysis complete with distinctive top 5 factors are: project material or equipment delivery delays (Supply Chain); delay in obtaining work permits; poor site management and supervision by contractors; contractor's poor planning and scheduling of projects; and owner's consuming long time for approval and decision-making.

Aljamee et al. (2019) conducted in-depth literature review and identified 20 causes of project delay. Survey data collected from Basra Oil Company Iran, employees' revels five root causes of project delay are as follows : "Accept the lowest bidding prices from the contractors"; "financial difficulty from the contractors"; "traditional paperwork more than software programs"; "poor project management planning"; and "official and unofficial Holidays".

Seddeeq et al. (2019) study assessed the causes of time and cost overrun. Through a review of in-depth literature identified 38 time & cost overrun causes duly verified by an interview of expert working in oil & gas Industry in Saudi Arabia. These causes were grouped into seven broad categories are: all parties-related, contract related,

consultant-related, contractor-related, owner-related, external-related and finally resources-related causes. Out of identified 38 causes 5 most significant causes impacting time & cost overrun (combined) were found to be "changing of design and scope by client during construction", "poor planning and scheduling of project", "design errors", "Inadequate comprehension of scope of work at the bidding stage", and "underestimating of cost and schedules/overestimating of benefits".

Kazemi et al. (2020) investigated Irani oil and gas construction project causes of delay, study adopted experts view followed by fuzzy delphi method. Identified 75 delay factors & then categories them into 11 major categories of Consultant, Owner, Contractor, labor, equipment, materials, design, law & regulations, contract & contractual relations managerial factor and environment factor. Managerial factor is newly identified delay factor in this study. Survey results were analyzed using best-worst method and relative importance-significant factor, environment factors and Managerial factors categories were ranked 1 & 2 respectively. Out of identified 75 delay factors, "financial problems & delays in payment by the owner", "weak project management by the contractor", "changes in the price of material", "technical & managerial weaknesses of consultants", "low efficiency of equipment", "low productivity of labor", "inappropriate organizational structure linking to the project changes in design", and "changes in laws and regulations" were identified as most critical delay causes.

Akhtar (2020) investigated petrochemical, oil and gas EPC projects in Middle-East with the aim to explore challenges and problems faced in EPC projects that lead to cost overrun and schedule delay, and to explore good practices to minimize impact on overall project. The case study reveals that factors contributing to schedule delay and cost overrun are : project complexity, weak or poor planning and control, aggressive unrealistic schedule, inherited bidding inaccuracies and estimation mistakes, ineffective leadership and poor decision-making, design changes, delay in placing POs, absence of project management practices, lack of team competency, late client approvals, late vendor information, delay in permit to work (PTW) issuance, inadequate construction resources, quality issues and reworks, and ignoring previous project's lesson learned. Further most, poor risk management, poor interface management between project stakeholders contributes to cost overrun and delays.

Author(s)	Type of Paper	Region	Delay and risk identified specific to Supply Chain Operations
Kumar (2016)	Journal Paper	India	1. Inadequate contractor's work & experience & also poor risk management and ignorance 2. Delay in material delivery especially while importing
Prasad et al. (2019)	Journal Paper	India	1. Delay in settlement of contractor claims; 2. Contractor's financial difficulties; 3. Subcontractor or suppliers; 4. Delay in payment of extra work/variations; and 5. Variation orders/change of scope by owner.
Saeedi and Karim (2020)	Journal Paper	Oman	1. Delay in start of purchasing long-lead items; 2. Tendering inadequate of main contractor's experience 3. Contractor poor procurement managements; 4. Poor understanding of scope of work
Kassem et al. (2020)	Journal Paper	Yaman	Tendering and contracting : 1. Inadequate Tendering 2. Lack of detailed Items 3. Corruption accompanying tenders 3. Unclear contract terms

Sylvester et.al (2011) performed this study to express project success based on Project Management Tringles (PMT) taking idea from "Iron Triangle-focusing schedule, cost and scope". Researchers suggested to keep strategic balance among Cost Management, Quality management, Time management, and Scope management in relation to oil and gas industry in Miri, Sarawak, Malaysia". Study investigated that, projects delayed, compromised on project specifications, budget overruns, and missed milestone in significant number of international high profiles projects leads to project failures.

Authors suggested that Project Management team always strive for maintaining effective and efficient balance among Time, cost, scope and quality.

Hoezen and Volker (2015) conducted case study on 2 projects and empirically express the importance of procurement negotiations for project success. European tendering procedure are well stipulated and guided towards the allocation of Contract for public construction projects. Research emphasis that both social and legal aspects of collaboration are critical for project success. However, developing trust between Buyer and Supplier is very difficult due to strong legal procedures. Authors argue that procurement phase of construction project is key towards developing successful cooperation between client and contractor. and also suggested strategy to parallel processes of organizational sensemaking and bargaining. Competitive dialogues reduce biases between the parties and helps in working jointly towards their possible investments, motivations, and perceived uncertainties to restricted tendering.

Al-Hajji and Khan (2016) investigated Kuwait Oil Company (KOC) capital EPC project management key techniques employed to mitigate causes of delays, recommend innovative and strategic techniques to capture maximum benefits which leads to mitigating schedule and budget concerns. Few of them are; lean Six sigma methodology to improve business processes by eliminating defects and implementing real time innovative methods, capturing the lesson learned, adopting effective contracting strategy, better payment terms with advance payment options in the contract, value engineering, incentive schemes, effective quality management systems and bringing collaborative team efforts.

Keung and Shen (2017) suggested business leaders to accept effective networking as a strategy to enhance their business competitive. Interfirm network (such as Joint Ventures, consortia, strategic alliances and corporate interlocks) strategy where companies develop and maintain webs of relationships with other industry players for business competitiveness. And secondly networks of relationships between companies that interact within the scope of one or several construction projects, such exchanges are conceptualized as project networks.

Stroh et. al (2018) conducted case studies and presented that oil & gas industry capital projects can also implement "Digital Project Delivery Methods" utilized by manufacturing industry. Presented benefits includes: "Greater collaboration and transparency between an EPC company and Owner"; "Use of real-time data to facilitate and drive better project decision-making"; and "Ability to save resources through increased efficiencies". Digital Project Delivery approach through Project Lifecycle Management (PLM) is compared to a legacy project delivery using disconnected tools. New ways of delivering capital project can be demonstrated by adapting PLM software features such as Brings together Engieering data with planning information, Collaboration review sessions, Digital action workflows and Status visualization using 3D model.

Almarar (2019) investigated and suggested the use of Agile project Management method (like SCRUM) along with Water fall management approach, for innovating processes and potentially reducing development time and increase the project success rate. Study discusses application of Stage Gate Process (SGP) having shared gatekeepers for different Engineering disciplines together with Agile approach (SCRUM) towards developing strategies during project EPC Phase.

Haass and Azizi (2019) investigated and confirmed the presented the framework of knowledge sharing practices in project-oriented organizations. This study focused on identification of knowledge sharing approaches, models, tools and techniques. 27 different knowledge sharing methods were known within the literature review, further categorized into four froms of information mechanisms. After that, based on Pareto principle, literature review, opinion of business professionals working in the field of knowledge and project management and in relation to the ten-knowledge space of PMBOK guide. Six (which is 20% of 27 nos.) knowledge sharing methods selected are : micro papers, lessons learned, mentoring, communities of practices, meetings and action review.

3. Description of Broad Problem Area

Oil & gas projects estimated cost is in the range of billion dollars and are getting executed in several packages at the same time. For example: in October 2015, Kuwait Integrated

Petroleum Industries Company (KIPIC) has invested $13 billion for building Al-ZOR Refinery, there are 5 key EPC packages identified & awarded to different EPC Contractors (Brelsford, 2015). Researcher seeks industry business leader's attention towards mega project execution problems and challenges in terms of identifying delay causes, its impacts on desired performance. The continues research & development is being required towards strong project execution practices and developing project success strategies and stories as per the market volatility aiming to overall project success.

3.1 Gaps in Research

There are limited academic & professional studies identified locally and globally investigating Indian Oil & Gas downstream Engineering Procurement & Construction (EPC) Construction industry mega projects delay causes and its impact on desired performance. There are ample of opportunities in the Oil & Gas EPC Construction industry where researchers can contribute towards capital / mega project success.

Global oil & gas consulting firms and published academic research literature mostly focused on EPC project execution challenges at broader aspect there are lack of case studies and focused in-depth studies particularly on delay causes, their impacts, best practices and strategies related to Engineering OR Procurement OR Construction as an individual area of concern.

Hence researcher proposed in-depth Study of Oil & Gas Mega EPC Project's Delay Causes and Its Impact on Desired Performance in the context of EPC Contractor's Supply Chain Operations

3.2 Problem Formulation

MOPSI (2020) Government of India, Ministry of Statistics and Programme Implementation (MOSPI), Infrastructure and Project Monitoring Division has published Report where out of 1695 projects on the Monitor of MOSPI, 144 belong to the Petroleum Sector. 58 Mega Projects (having Project cost greater then Rs. 1000 Crores) and 86 Major Projects. Indian Petroleum Mega Projects need extensive research to investigate cost overruns and schedule delay causes. Presently cost overrun in the range of 5.8% to 114.26% and schedule delays from 3 Months to 112 Months. Main reasons of time overruns & cost overrun identified in the report are: "land acquisition concerns", "project clearances from forest/environment department", "Delay in

finalization of detailed engineering", "change in scope, Delay in tendering", "project financing concerns", "law & order problems", "pre-commissioning punch point closer troubles and contractual issues", "geological surprises", "contractual issues, Inadequate manpower", "long lead equipment ordering & supply delays" and "Delay in technical approvals".

Mega EPC project Engineering functioning, Procurement operations and Construction work individually required in-depth research & investigate to find delay causes specific to their operations respectively. Procurement Operations (Supply Chain operations) is responsible for the spending of 50% -70% of total overall project cost/budget. So researcher propose in-depth study of supply chain project operations stages key challenges resulting project delays, their impacts and then preparing best in class practices, strategies and stories to help the project success Oil & gas projects. This study entirely focusing the petrochemical, oil & gas industry mega projects.

4. Objective of the Study

1. Investigate the performance criteria of downstream projects for Oil and Gas Sector.
2. To determine the Supply Chain operational factors contributing to project delay in downstream projects for Oil and Gas Sector.
3. To access impact of Supply Chain operations delays in Engineering Procurement and Construction projects for Oil and Gas Sector.
4. Develop a practical framework to improve Supply Chain operations performance resulting overall project success for Oil and Gas Sector.

5. Methodology to be adopted

5.1 Methodology

In-depth exploratory fact finder critical review will be undertaken to capture Mega EPC project supply chain operation "delay causes", "Impact of delays", "Project & Business Risk" and "Project and organizational Success" in context to EPC Contractor viewpoints. A literature study is organized to keep focused on oil and gas downstream: refineries, Pipeline, petrochemical business segments. Region under focus is "India, Countries under Asia Continent".

5.2 Data Collection

The primary data collection will be collected through Structured questionnaire from industry expert.

Secondary data will be obtained aligning to research topic from reference books-Engineering, design and Supply Chain operations, Industry statistics published by government ministries, Energy Outlooks (Indian and Global), magazine articles, journals published work, Conference proceedings, research reports of global consulting companies, client strategy meets and their published reports, digital media publication issued by project management consultants /Advisors, and many more.

5.3 Sampling

The sample size for the research will be approx. 450 respondents. The sampling technique to be adopted in the research is chosen to be "non-probability convenient sampling".

5.4 Statistical Tools & Techniques

It is being envisaged that Excel & SPSS tools shall be used to analysis the primary date using statistical techniques like; calculate mean, variance, important index value and rank, ANOVA, Spearman's rank correlation etc.

6. Expected Outcomes of the Research

This research will identify mega projects supply chain operations delay causes and its impact on oil and gas projects. Oil and gas sector projects fulfill appx. 32% of overall energy demand of India (IEA, 2020). The sustainable long run business is the present need of the industry. The study will help policy makers and industry leaders to develop mitigation majors, appropriate strategies and best practices to reduce the delays and their impacts in terms of schedule delays, cost overruns, reduction in profit margins, disputes, arbitration and abandonment of projects at the most.

7. Conclusion

In today's environment EPC Contractors are offering attractive pricing, over aggressive schedule, quality and safety commitment to the project owners/ clients just to service in the rapid evolving highly competitive global market priorities are shifting from

sustainability and profitable business to survivals. EPC companies return of Investment (ROI) information and financial statements are self-explanatory. EPC sector companies needs to work strongly to overcome with attributes to project deviations related to delays, its impact and strategically work towards minimize cost and schedule overruns at the most.

8. Reference:

A Kassem, M., Khoiry, M. A., & Hamzah, N. (2020). Theoretical review on critical risk factors in oil and gas construction projects in Yemen. In *Engineering, Construction and Architectural Management* (Vol. 28, Issue 4, pp. 934–968). Emerald Group Holdings Ltd. https://doi.org/10.1108/ECAM-03-2019-0123

Ahsan, K., & Gunawan, I. (2010). Analysis of cost and schedule performance of international development projects. *International Journal of Project Management*, *28*(1), 68–78. https://doi.org/10.1016/j.ijproman.2009.03.005

Akhtar, M. (2020). Dealing with EPC Project Management Problems and Challenges A Case Study on Petrochemical, Oil and Gas EPC Projects in Middle-East. Paper presented at the Abu Dhabi International Petroleum Exhibition & Conference, Abu Dhabi, UAE, November 2020. doi: https://doi.org/10.2118/203431-MS

Al-Hajji, H., & Khan, S. (2016). Keeping Oil & Gas EPC Major Projects Under Control: Strategic & Innovative Project Management Practices. Paper presented at the Abu Dhabi International Petroleum Exhibition & Conference, Abu Dhabi, UAE, doi: https://doi.org/10.2118/182970-MS.

Alhajri, A. R., & Alshibani, A. (2018). Critical factors behind construction delay in petrochemical projects in Saudi Arabia. *Energies*, *11*(7). https://doi.org/10.3390/en11071652

Aljamee, H., Naeem, S., & Bell, A. (2020). The causes of project delay in Iraqi petroleum industry: A case study in Basra Oil Company. *Journal of Transnational Management*, *25*(1), 57–70. https://doi.org/10.1080/15475778.2019.1698935

AlMarar, M. S. (2019). EPC strategies for a successful project execution. Paper presented at the SPE Gas & Oil Technology Showcase and Conference, Dubai, UAE, October 2019. doi: https://doi.org/10.2118/198578-MS

Bianco, A. (2020). The Role of FEED Front End Engineering Design In The EPC Execution Strategy. Paper presented at the International Petroleum Technology Conference, Dhahran, Kingdom of Saudi Arabia. doi: https://doi.org/10.2523/IPTC-20135-Abstract

BIC Magazine Digital Edition (2021 Mar/Apr). From the Publisher : End of Energy dominance? We aren't going away. Retrieved from : https://epubs.democratprinting.com/publication/?i=694780

Brelsford, R. (2015, August 27). Kuwait lets contract for grassroots Al-Zour refinery. Retrieved from: https://www.ogj.com/refining-processing/refining/operations/article/17245111/kuwait-lets-contract-for-grassroots-alzour-refinery

Chandrasekaran, S., Kalidas, S., Mir, M., Nel, G., Parbhoo, P., Rao, A., & Srikanthan, S. (2021). McKinsey & Company Reprot. Capital Projects 5.0: Reimagining capital-project delivery.https://www.mckinsey.com/business-functions/operations/our-insights/capital-projects-50-reimagining-capital-project-delivery

Deloitte (2014). Vision 2040 : Global scenarios for the oil and gas industry. Retrieved from : https://www2.deloitte.com/content/dam/Deloitte/ru/Documents/energy-resources/ru_er_vision2040_eng.pdf

Deloitte Oil & Gas . (2015). Elevating the success of oil and gas capital projects. Deloitte Center for Energy Solutions. Retrieved from: https://www2.deloitte.com/content/dam/Deloitte/us/Documents/energy-resources/us-er-oil-and-gas-capital-projects-service-offerings-04292015.pdf

Deloitte (2015). Oil & Gas Reality Check 2015; A look at the top issues facing the oil & gas sector. https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Energy-and-Resources/gx-er-oil-and-gas-reality-check-2015.pdf

Dey, P. K. (2012). Project risk management using multiple criteria decision-making technique and decision tree analysis: A case study of Indian oil refinery. In *Production Planning and Control* (Vol. 23, Issue 12, pp. 903–921). https://doi.org/10.1080/09537287.2011.586379

Dey, P. K. (2010). Managing project risk using combined analytic hierarchy process and risk map. *Applied Soft Computing Journal*, *10*(4), 990–1000. https://doi.org/10.1016/j.asoc.2010.03.010

Doloi, H., Sawhney, A., Iyer, K. C., & Rentala, S. (2012a). Analysing factors affecting delays in Indian construction projects. *International Journal of Project Management*, *30*(4), 479–489. https://doi.org/10.1016/j.ijproman.2011.10.004

Doloi, H., Sawhney, A., & Iyer, K. C. (2012b). Structural equation model for investigating factors affecting delay in Indian construction projects. *Construction Management and Economics*, *30*(10), 869–884. https://doi.org/10.1080/01446193.2012.717705

EYGM Limited (2017). *Oil and gas megaproject development : Project development to FID. Retrieved from:* https://extractiveshub.org/servefile/getFile/id/6904

Faisal Mahmood, S. (2020). Brownfield Projects Cost & Schedule Optimization. Paper presented at the Abu Dhabi International Petroleum Exhibition & Conference, Abu Dhabi, UAE, November 2020. doi: https://doi.org/10.2118/203110-MS

Fluor Corporation Investor Release (2021, January 11). Fluor Announces New Business Segments and Intent to Divest Its Maintenance Services Business. Retrieved from : https://investor.fluor.com/news-releases/news-release-details/fluor-announces-new-business-segments-and-intent-divest-its

Hoezen, M. & Volker, L. (2015). The importance of procurement negotiations for project success. IPMA Projectie Magazine. 2-8. Retrieved from: https://www.researchgate.net/publication/280084760_The_importance_of_procurement_negotiations_for_project_success

Haass, O., & Azizi, N. (2019). Knowledge sharing practice in project-oriented organisations: a practical framework based on project life cycle and project management body of knowledge. In *Int. J. Project Organisation and Management* (Vol. 11, Issue 2), *pp.171–197.* https://doi.org/10.1504/IJPOM.2019.100575

Indian Brand Equity Foundation (2021, May). Executive Summary: Oil & Gas. www.ibef.org, Retrieved from : *https://www.ibef.org/industry/indian-oil-and-gas-industry-analysis-presentation*

International Energy Agency (2020). India 2020:Energy Policy Review. www.ieg.org Retrieved from: *https://niti.gov.in/sites/default/files/2020-01/IEA-India%202020-In-depth-EnergyPolicy_0.pdf*

K.V, P., Vasugi, V., R, V., & Bhat, N. (2019). Analysis of causes of delay in Indian construction projects and mitigation measures. *Journal of Financial Management of Property and Construction*, *24*(1), 58–78. *https://doi.org/10.1108/JFMPC-04-2018-0020*

Kazemi, A., Katebi, A., & Kazemi, M.-H. (2018). Causes of delay in construction projects: The case of oil and gas projects. *International Journal of Advanced Research in Engineering*, *4*(1), 11. *https://doi.org/10.24178/ijare.2018.4.1.11*

Kazemi, A., Kim, E. S., & Kazemi, M. H. (2020). Identifying and prioritizing delay factors in Iran's oil construction projects. *International Journal of Energy Sector Management*, *15*(3), 476–495. *https://doi.org/10.1108/IJESM-04-2020-0006*

Keung, C., & Shen, L. (2017). Network strategy for contractors' business competitiveness. *Construction Management and Economics*, *35*(8–9), 482–497. *https://doi.org/10.1080/01446193.2017.1329539*

Kumar, D. (2016). Causes and Effects of Delays in Indian Construction Projects. In International Research Journal of Engineering and Technology (IRJET).e-ISSN: 2395 -0056 Volume: 03 Issue: 04 | p-ISSN: 2395-0072 © 2016, IRJET | Impact Factor value: 4.45 | ISO 9001:2008 Certified Journal | Page 1831-1837. www.irjet.net

Keane, P. J., Caletka, A.,F. (2008). Delay Analysis in Construction Contracts Publisher - Wiley-Blackwell, 2008, ISBN 978-1-4051-5654-7).

KPMG-India, Project Management Institute (PMI) & Ministry of Statistics and Programme Implementation (MOSPI).(2012). Study on Project Schedule and Cost Overruns, Expedite Infrastructure Project [White Paper]. Retrieved from : https://www.pmi.org.in/pdfs/white_paper/PMI_WhitePaper__301120171237_study-on-project-schedule-and-cost.pdf

Ministry of Statistics and Programme Implementation (2020, Oct/Dec). GOVT. Of INDIA : PROJECT IMPLEMENTATION STATUS REPORT OF CENTRAL SECTOR PROJECTS. Retrieved from: http://www.cspm.gov.in/english/qr/Oct_Dec_2020.pdf

PricewaterhouseCoopers (PwC). (2016). Engineering Procurement and Construction (EPC) Contracts in the Oil and Gas Sector. www.pwc.com.au. Retrieved from : https://www.pwc.com.au/legal/assets/investing-in-infrastructure/iif-5-epc-contracts-oil-gas-feb16-3.pdf

Preiss, A. (2014). EYGM regular presentation on Spotlight on oil and gas megaprojects. Retrieved from: https://www.wko.at/site/OEGEW/Veranstaltungen/Vortrag-Axel-Preiss.pdf

PSU Connect (2017, February **09).** Govt mulls merger of 6 consulting firms in the EIL. Retrieved from: https://www.psuconnect.in/news/Govt-mulls-merger-of-6-consulting-firms-in-the-EIL/13881/

Pulsinelli, O. (2020, June 4). McDermott International Inc. Sells former CB&I pipe fabrication assets, new Co. formed. Retrieved from: https://www.bizjournals.com/houston/news/2020/06/04/mcdermott-sells-shaw-assets.html

Ruqaishi, M., & Bashir, H. A. (2015). Causes of Delay in Construction Projects in the Oil and Gas Industry in the Gulf Cooperation Council Countries: A Case Study. *Journal of Management in Engineering*, *31*(3), 05014017. https://doi.org/10.1061/(asce)me.1943-5479.0000248

Sylvester, D. C., Rani, N. S. A., & Shaikh, J. M. (2011). Comparison between oil and gas companies and contractors against cost, time, quality, and scope for project success in Miri, Sarawak, Malaysia. African Journal of Business Management, *5(11), 4337–4354.* https://doi.org/10.5897/AJBM10.1369. *Retrived from:*https://academicjournals.org/journal/AJBM/article-abstract/73C865415849

Salim Al Saeedi, A., Mahbub Karim Dean, A. (2020). Analyzing the Performance of Mega Construction Projects in Oman: A Study of Selected Projects from Oil & Gas Sector. *American International Journal of Business and Management Studies*, *2*(2). DOI: 10.46545/aijbms.v2i2.247

Seddeeq, A. Bin, Assaf, S., Abdallah, A., & Hassanain, M. A. (2019). Time and cost overrun in the Saudi Arabian oil and gas construction industry. *Buildings*, *9*(2). https://doi.org/10.3390/buildings9020041

Stroh, J., Naik, H., Memi, M. (2018). Improved Collaboration and Transparency of Oil & Gas Capital Projects Using a Digital Project Delivery System. Paper presented at the SPE Annual Technical Conference and Exhibition, Dallas, Texas, USA. doi: https://doi.org/10.2118/191550-MS

Shyamal, S. (2014). Engineering Procurement and Construction (EPC): Making India brick by brick. Ernst & Young LLP. Published in India. Retrieved from: http://www.mvomni.com/assets/images/news/EY-making-india-brick-by-brick2.pdf

TechnipFMC (2021, January 07). TechnipFMC announces resumption of activities toward separation into two Industry-Leadings, Independent, Publicly Traded Companies. Retrieved from : https://www.technipfmc.com/en/media/press-releases/2021/01/technipfmc-announces-resumption-of-activities-toward-separation-into-two-industry-leading-independent-publicly-traded-companies/?type=press-releases

TechnipFMC. (2018, January 29). Fundamentals of Upstream, midstream and downstream : Take a look inside the oil & gas journey from discovery yo the end consumer [Video]. YouTube. https://www.youtube.com/watch?v=6ozmKhahk8M

Wu, Kuo-Jui & Chiu, Anthony & Tseng, Ming-Lang. (2011). Supply chain management strategy practices in Taiwan. IEEE. doi :10.1109/APBITM.2011.5996326. Retrieved from:https://www.researchgate.net/publication/252033042_Supply_chain_management_strategy_practices_in_Taiwan/comments

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